Results from GPS data

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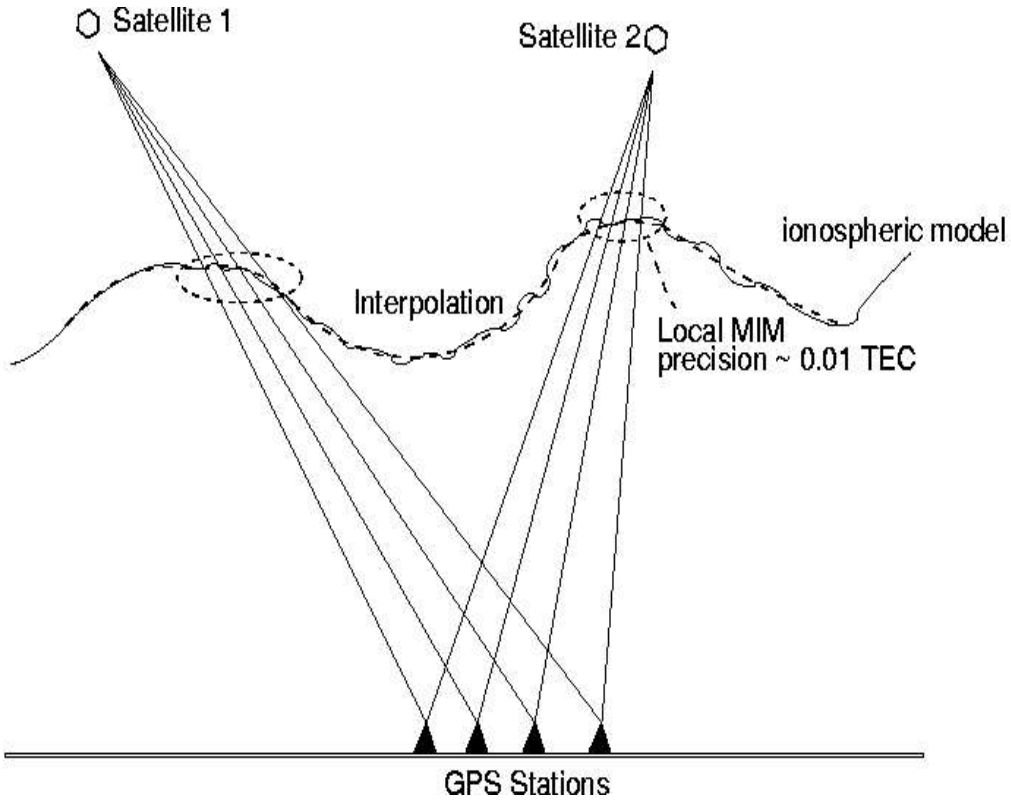
LA region

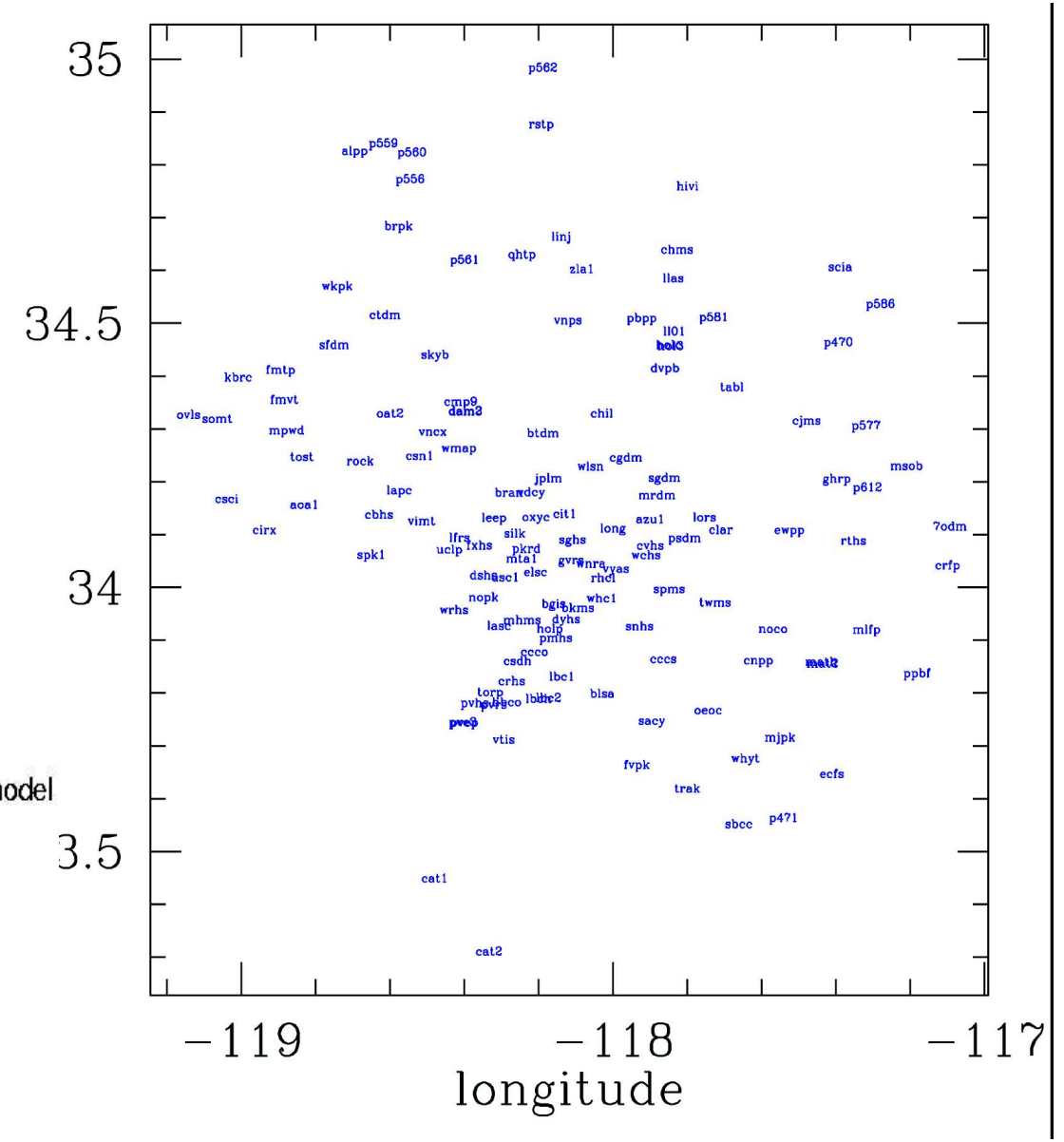
GPS data of 122 stations, 32 satellites

Max. distance: ~190 km

Min. elevation angle 30º

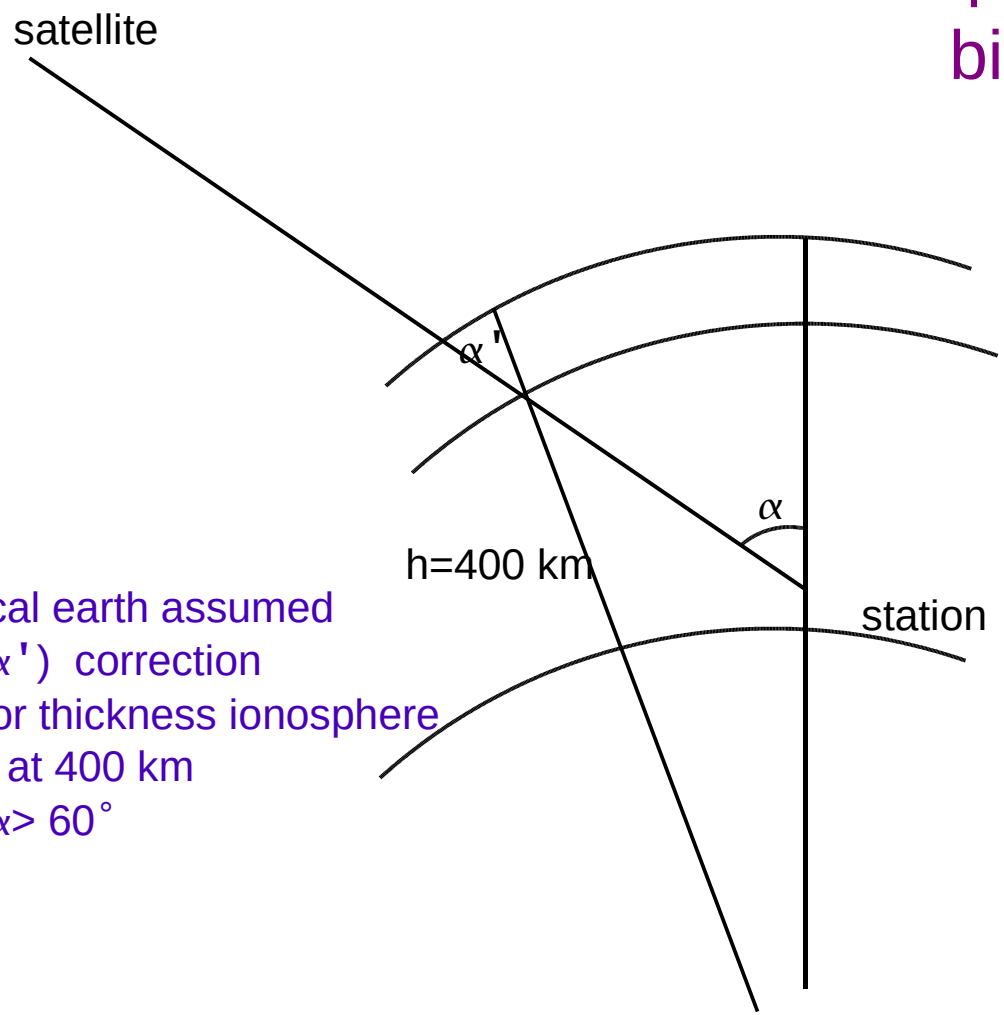
Total FOV ~1000 km





New data: GPS data of 690 stations ~1000km around LA not analyzed yet

Piercing Points

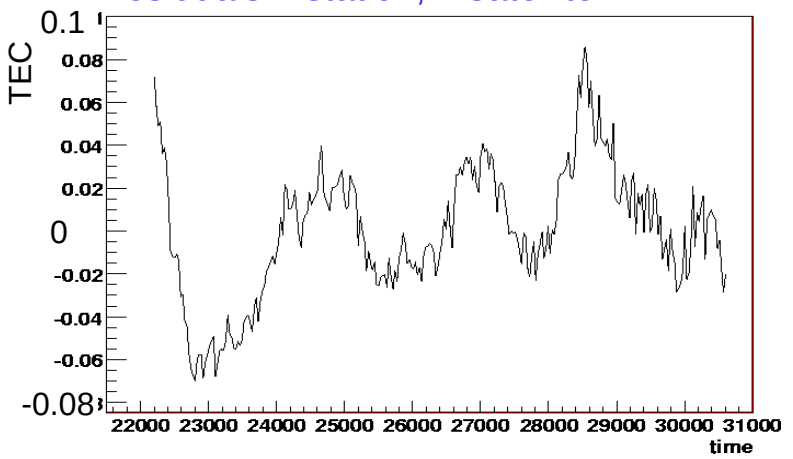


spherical earth assumed
1/cos(α') correction
for thickness ionosphere
fixed h at 400 km
cut at α> 60°

Separate MIM-parameters from bias via 1/cos(α') term:

- Ionosphere +cos(α'): position + time dependent
- bias: constant
- simultaneous fit of MIM + bias possible over longer times

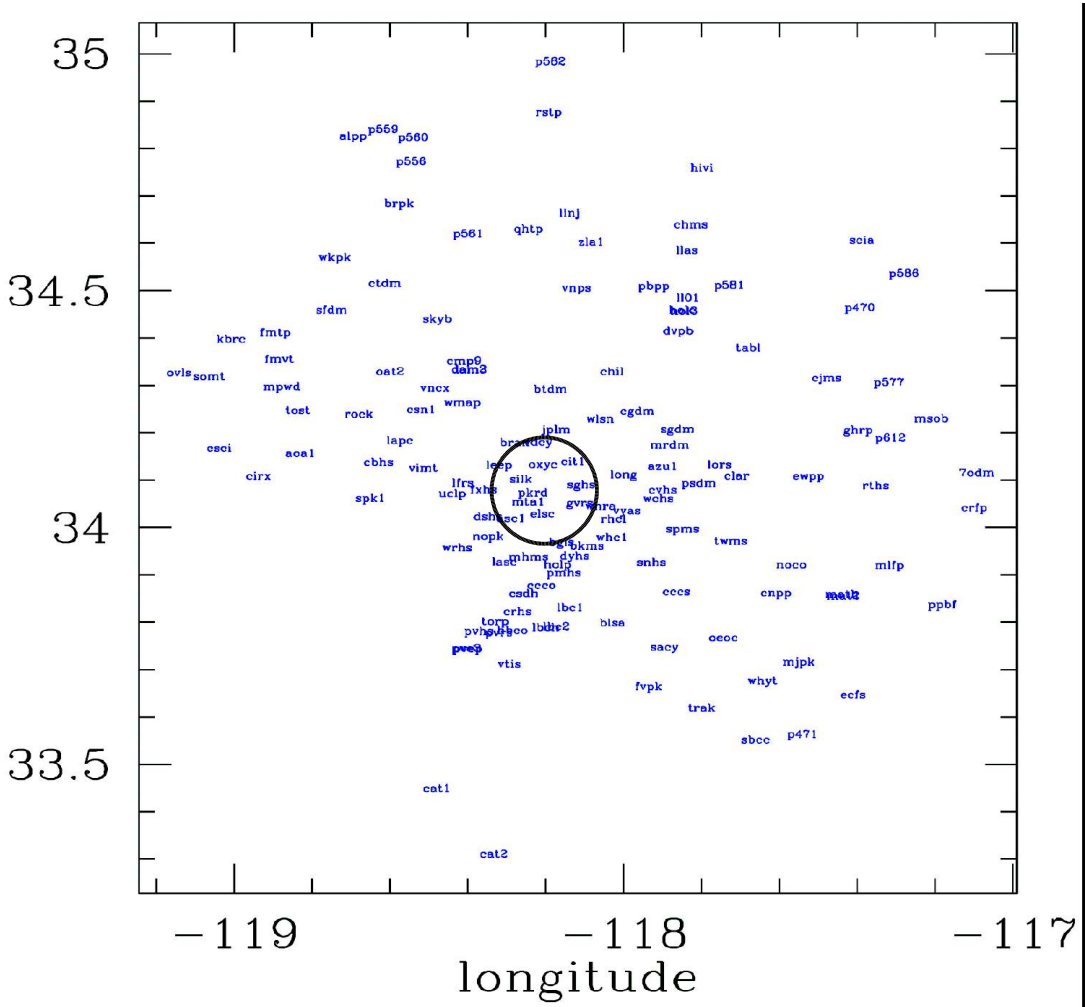
Residuals 1 station, 1 satellite

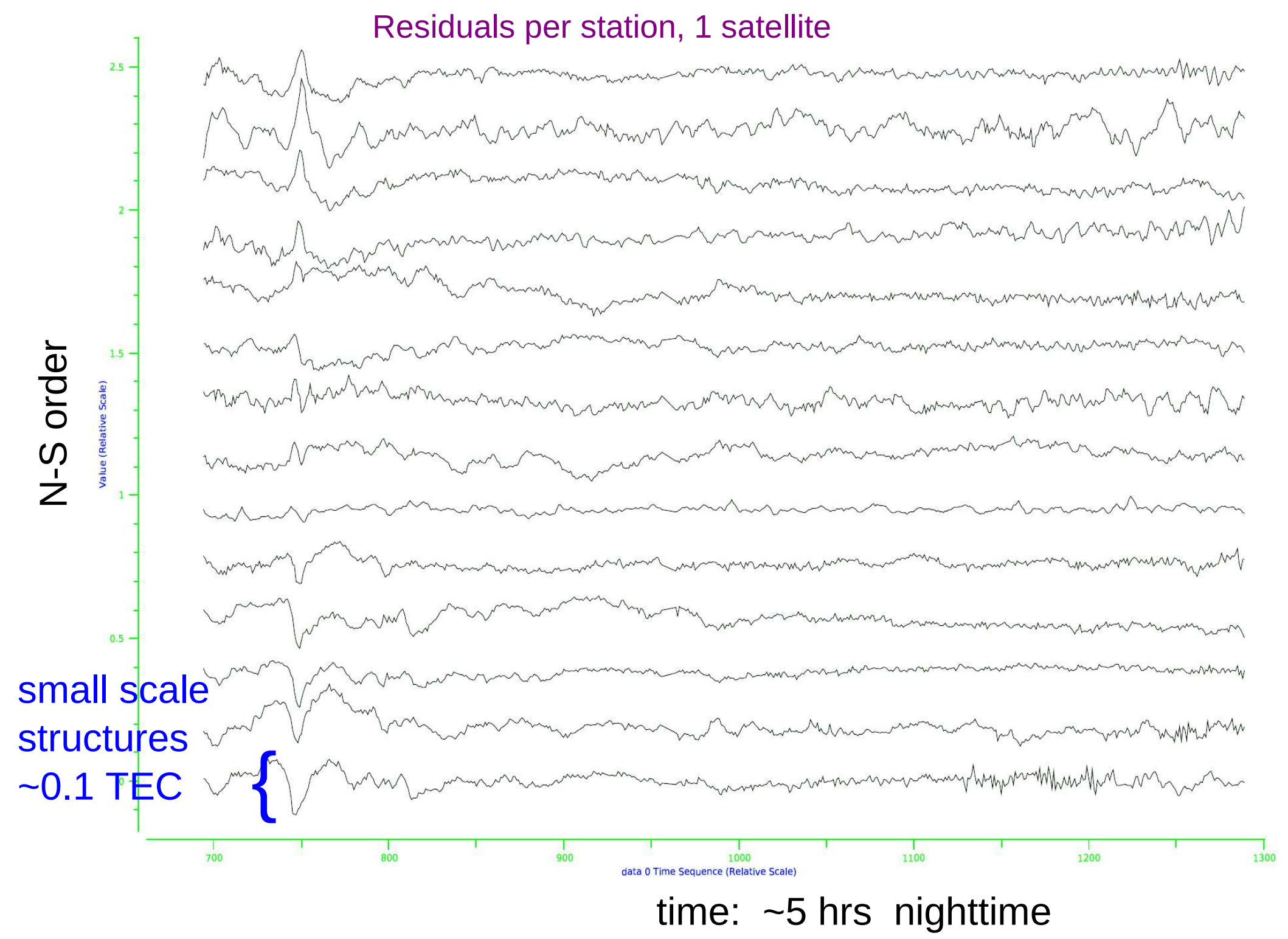


$$\text{Residuals} = \text{MIM}(t)\cdot 1/\cos(\alpha'(t)) - \text{TEC}_{\text{measured}} - \text{bias}_{\text{sat,station}}$$

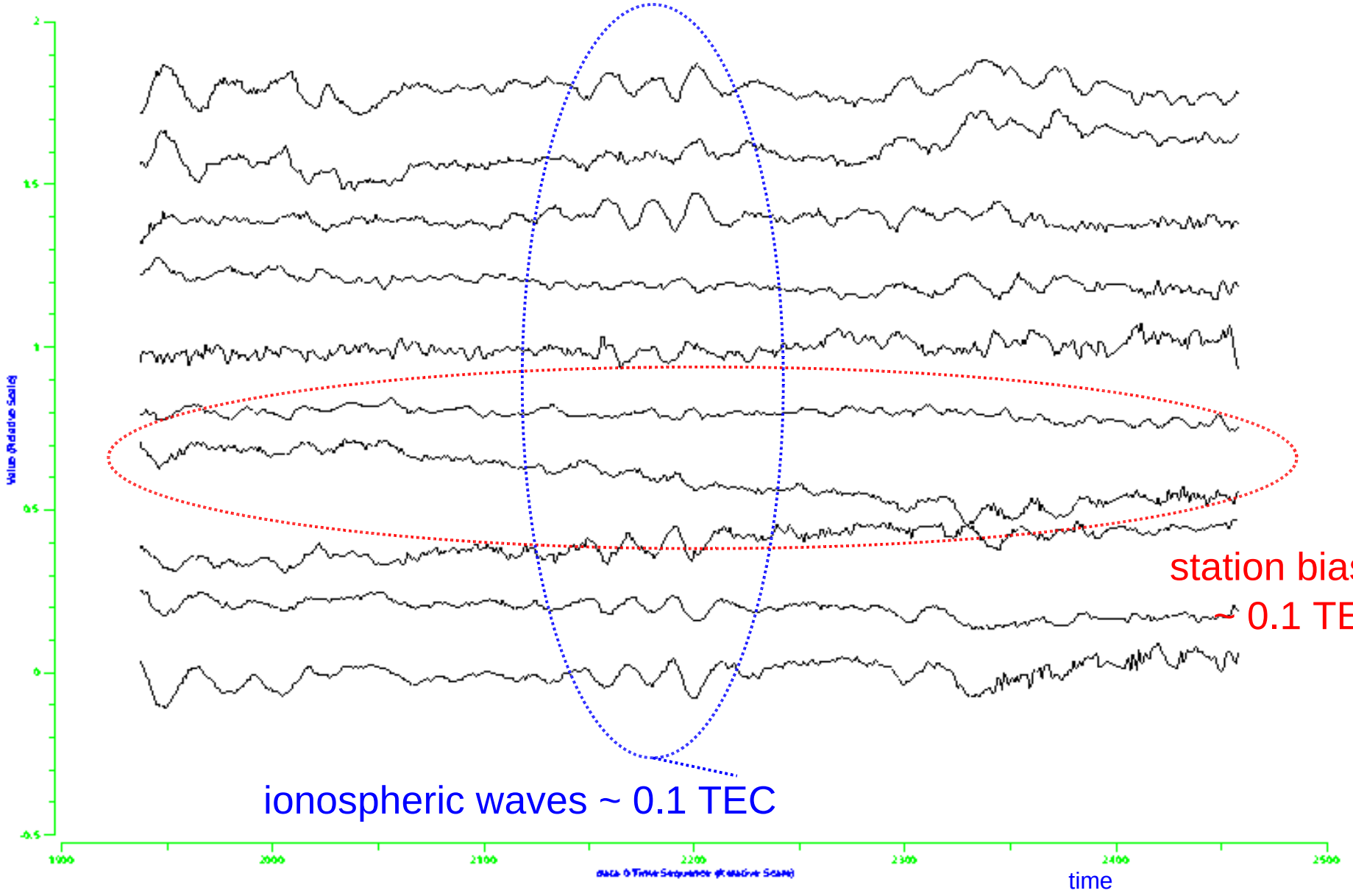
Local MIM

Selected group of 10 nearby stations
Max. distance ~ 30 km
1 satellite at a time
Get MIM from average TEC values (after bias correction)




Residuals per station, 1 satellite
N-S order
Value (Relative Scale)
2.5
2
1.5
1
0.5
0
700
800
900
1000
1100
1200
1300
data 0 Time Sequence (Relative Scale)
small scale
structures
~0.1 TEC
time: ~5 hrs nighttime

Residuals per station, 1 satellite



station bias-drift
~ 0.1 TEC

ionospheric waves ~ 0.1 TEC

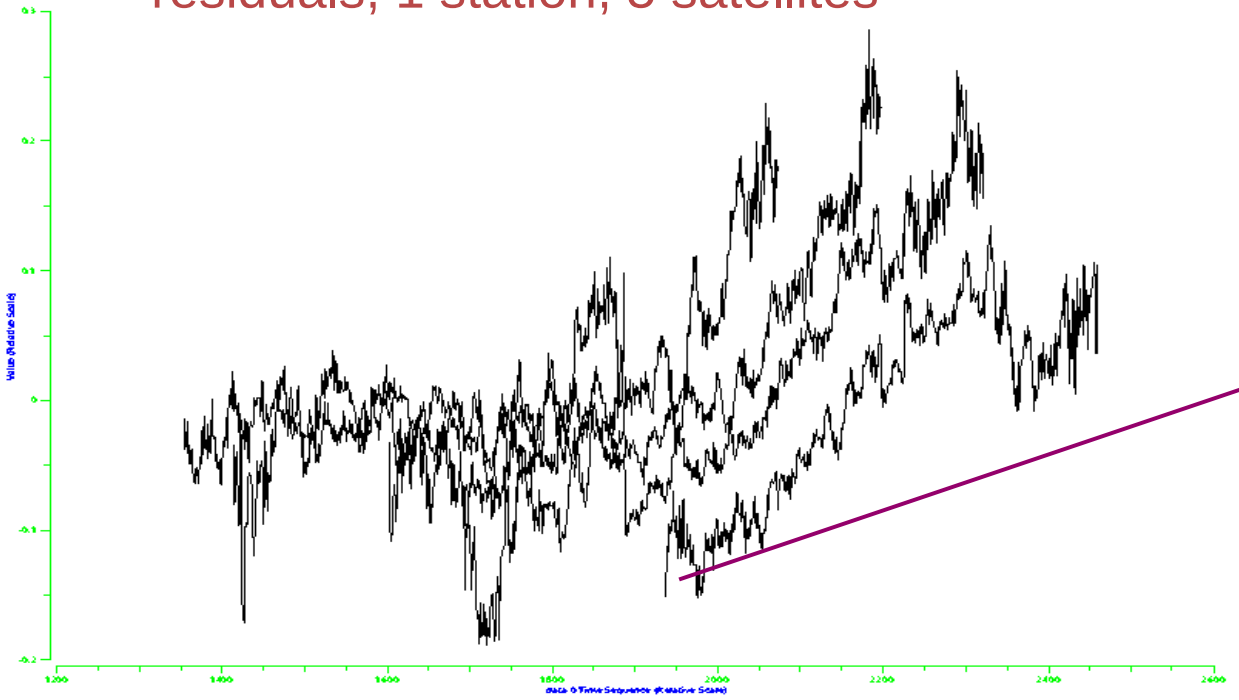
time: ~5 hrs daytime

Station bias-drift

Some stations show time dependent “drifting” biases

- Difficult to separate from time dependent ionosphere
- Same effect for more satellites (at the same time), so really station dependent (temperature, angle...?)
- Can be taken out by using a fit per station on data from different satellites
- Still looking for explanations (use 3 days data)

residuals, 1 station, 5 satellites



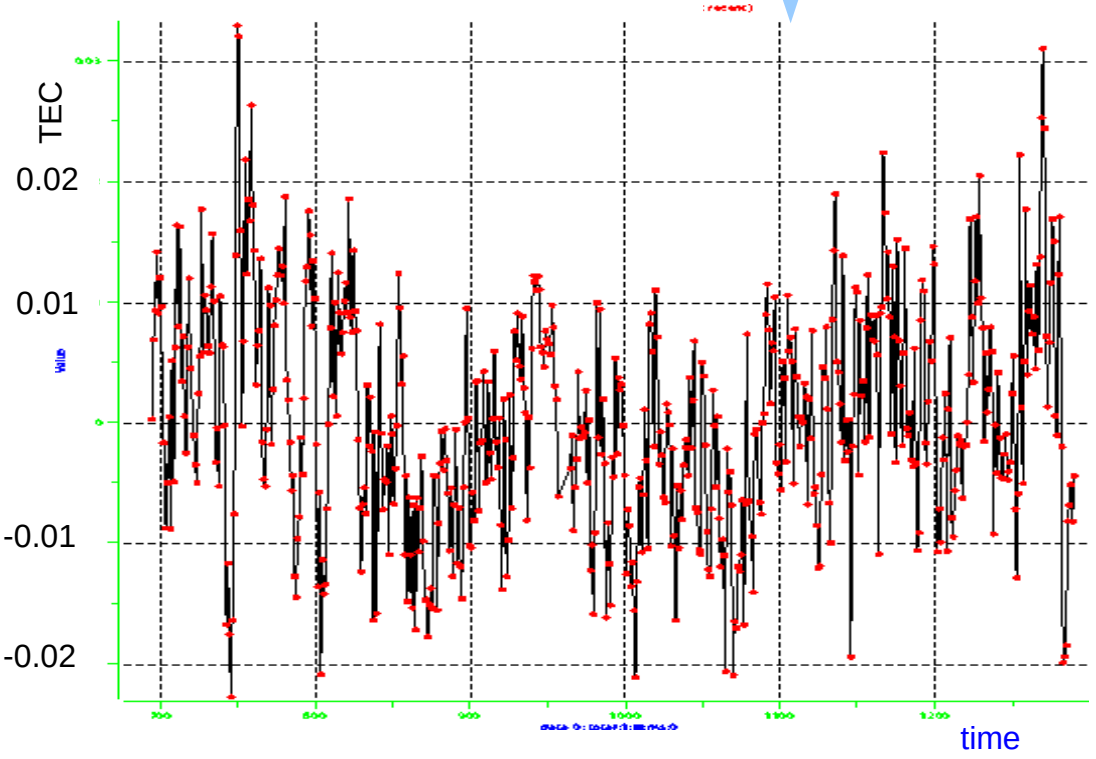
steep increase for all satellites at the same time
different offset due to bias differences

time

Fit 1st order local MIM

Fit bias-drift per station

Residuals 1 station, 1 satellite



- Measurement errors ~ 0.01 TEC

  = ~1 rad @ 75 MHz

- Best fit so far: ~0.01 -0.02 TEC
- Commercial GPS station networks in the Netherlands
- Can provide good starting point for LOFAR calibration

Ongoing work:

- increasing area by including more stations
- better handle on time dependent bias